Resonance:

A **resonator** is something that can **resonate**, i.e., something that can vibrate or allows the propagation of waves. Examples:
- Ocean, lake (water waves)
- Vacuum (electromagnetic waves)
- air (sound waves)
- pipe, tube, flute, wind instrument
- string, metal bar, xylophone
- microwave or laser cavity
- RLC-circuit

Some resonators (ocean, interstellar space, air) allow waves of all wavelengths. Other resonators allow only waves with certain wavelengths. This phenomenon is called **resonance**.

An RLC circuit has a **center frequency**, where the attenuation of a vibration is minimal. This is called the **resonance frequency**. The width of the resonance is determined by the damping resistor.

Finite resonators may have **boundary conditions** (nodes or antinodes at the ends). There is a series of standing waves called **harmonics** which satisfy the boundary conditions. The harmonics are also called **eigenmodes** or **eigenfrequencies**, since the problem of solving the wave equation with boundary conditions is similar to finding the **eigenvalues** of matrix (linear algebra).

Strategy for solving resonant standing wave problems:

What is the nature of the boundary conditions: Is there a node or an antinode on each end ?

Distance between two nodes: $\lambda/2$
Distance between two antinodes: $\lambda/2$
Distance between a node and an antinode: $\lambda/4$

Standing waves on a string usually have nodes on both ends.

A standing sound wave has a node, if the end of the resonator (pipe) is closed. It has an antinode, if the end of the resonator is open.